

10/575314

[10191/4504]

IAP20 Rec'd of CPTO 10 APR 2006

# CONTROL UNIT

## Background Information

The present invention is directed to a control unit according to the definition of the species in the independent claim.

## Advantages of the Invention

5 The control unit according to the present invention, having the features of the independent claim, has the advantage that when temporary interruptions occur in the oscillations of an oscillator for a processor in a control unit, these  
10 interruptions, which may occur for example due to temperature dependencies or shunt resistances in the oscillator circuit, are stored in an error memory. In particular, this avoids unnecessary visits to the repair shop which a customer would have made in response to a brief illumination of the warning lamp, the shop then not being able to determine why the  
15 warning lamp was activated.

The control unit according to the present invention makes it possible to write this error to a permanent error memory of the control unit. This improves the possibilities for servicing control units, in particular in the case of airbag  
20 triggering devices. Oscillators which are temporarily not oscillating are identified, and these errors are stored in the memory.

Advantageous improvements on the control unit specified in the independent claim are possible as a result of the measures and  
25 refinements set forth in the subclaims.

It is especially advantageous that the control unit has a logic module which, when oscillation is absent, sets a second error memory to a predefined state; the logic module then stores the absence in the first error memory depending on the state of the second memory. That solves the problem that the microprocessor or microcontroller in the control unit does not work if the oscillation of the oscillator is absent.

Consequently it is not possible to write to the memory assigned to the processor, i.e. a rewritable memory, for example an EEPROM. A second error memory is therefore proposed, which is set to a predefined state by a simple logic circuit depending on the absence of the oscillation. This state indicates the error that oscillation failed at least temporarily, or that its amplitude was too small to clock the connected ASICs reliably. If oscillation begins again, the microprocessor is able to write the error message that an absence of oscillation has occurred to the first error memory assigned directly thereto as a function of the state of the second error memory. This simplifies the identification of such errors significantly.

It is also advantageous that a timer module is assigned to the logic module in such a way that after a predetermined time after the supply voltage is switched on, determined by the timer module, the second error memory is set to the state in which the error is indicated. That advantageously prevents the clock oscillator from having sufficient time after power-up, e.g. 5 seconds, to begin oscillating. During subsequent operation, this blocked timer is non-functional, so that even short interruptions result in an entry in the error memory and possibly in activation of a warning lamp.

Moreover, it is advantageous that the control unit resets the second memory after oscillation begins again, since the error message, which may then be read out, is then written to the

memory which is assigned to the microprocessor. Now the external memory is again usable for a new error; it may therefore be designed in a simple manner in order to be set to the particular state by a simple logical signal 0 or 1.

5 Finally, it is also advantageous that the logic module continues to generate a signal that identifies the absence of oscillation until the first error memory is read. For example, this signal may activate the warning lamp until the error memory is read. At the same time, it may also be required for  
10 the error message to be deleted after being read in order to ensure that the warning lamp is turned off.

#### Drawing

An exemplary embodiment of the present invention is illustrated in the drawing and explained in greater detail in  
15 the following description.

Figure 1 shows a block diagram of the control unit according to the present invention, and

Figure 2 shows a flow chart explaining the function of the control unit.

#### 20 Description of the Exemplary Embodiment

In electronic control units, an oscillator is necessary for the processor or microcontroller to function. This oscillator produces the clock cycle or cycles with which the processor and the connected components operate. It is possible that the  
25 oscillator, for example a Pierce crystal oscillator, does not begin to oscillate after the power is turned on. Also, during operation there may already be sporadically occurring interruptions in the oscillation signal of the oscillator, or decreases in the amplitude of the oscillation signal which are  
30 incompatible with the connected components. The problem in

this context is to identify and store this error, so that the repair shop is able to identify the error in order to ultimately correct it.

According to the present invention, it is proposed that this temporary absence be stored in a first error memory, i.e., an EEPROM assigned directly to the microcontroller, if the oscillation will begin again after the interruption. This is preferably achieved by a logic module setting an external EEPROM, and depending on this setting writing the message that there was an oscillation interruption to the first error memory when oscillation begins again. That enables the error to be retrieved for inspection. The logic module may use a timer, which determines the minimum time by which oscillation must have begun after the power supply is turned on in order to justify an entry in the error memory. This value may be 5 seconds, for example. This second memory, which is switched back and forth between two states, is reset after oscillation begins again, in order to be ready to indicate another error. Advantageously, provision is made for a warning lamp to remain illuminated until the error has been read from the error memory and possibly deleted.

Figure 1 shows a block diagram of the construction of the control unit, omitting all components which are not necessary to explain the invention. A microcontroller  $\mu C$  transmits its clock signal ECLK to a module PIC, clock signal ECLK having been generated on the basis of a signal from an oscillator, for example a Pierce crystal oscillator. Assigned to microcontroller  $\mu C$  is a rewritable memory 15, designed here in the form of an EEPROM. This is a memory which is rewritable. This memory is made up of transistor structures. Module PIC stands for Peripheral Interface IC. Module PIC generates a logic signal based on interruptions in the clock signal or on excessive decreases in amplitude of the clock signal. A timer

module 10 is connected to the power supply via connector 11. Hence oscillation must be present 5 seconds after power-up to prevent identification of an error. If not, an error is present. Depending on this test, timer 10 delivers a logical  
5 output signal to a first inverting input of an AND gate 12. The output signal of the PIC module, i.e., whether or not there is an absence of oscillation, is applied to a second input of AND gate 12. If both timer 10 and module PIC show that oscillation is absent at least 5 seconds after the supply  
10 voltage is turned on, an external memory module 14 which is also in the form of an EEPROM is set to a predefined state by the output signal of AND gate 12. Therefore if both timer module 10 and module PIC indicate that oscillation is absent, AND gate 12 sets EEPROM 14 to a predefined state. Memory 14  
15 may be reset via an output signal from memory 15. This occurs if the oscillation absence error has been stored in internal memory 15 of  $\mu C$ , no more oscillation absences occur, and microcontroller  $\mu C$  functions normally. The second output signal from module PIC is given not only to AND gate 12, but  
20 also to an AND gate 13, namely to the latter's inverting input. The output signal from memory 14 is applied to a second input of AND gate 13. If memory 14 shows oscillation to be absent and module PIC does not, so that oscillations are occurring again and microcontroller  $\mu C$  is functioning, memory  
25 15 is activated so that an error message is written to the effect that a temporary interruption in the oscillation of the oscillator has occurred. The output signal from memory 14 is also applied to a first input of an OR gate 16, so that if memory 14 is set to show that an oscillation interruption has  
30 occurred, the output signal from OR gate 16 is in any case a logical 1 so that a warning lamp is activated. The error bit of memory 15 is connected to a second input of OR gate 16, i.e., the warning lamp is also activated if memory 15 also recognizes that there was an error.

Figure 2 explains in a flow chart the function of the control unit. In procedural step 199, the power-up of the supply voltage is detected and timer 201 is started. Procedural step 200 determines that an oscillation interruption has occurred.

5    Procedural step 201 tests whether this persists until 5 seconds after the start of the supply voltage. If not, the procedure ends in procedural step 202. But if so, memory 14 is set in procedural step 203 via the logic module from modules PIC 10 and 12 to the state in which an oscillation

10    interruption has occurred. In addition, the warning lamp is activated in [procedural step] 204 via module 16. Procedural step 205 tests whether oscillation has again begun. If not, the warning lamp remains on and the procedure ends in procedural step 206. But if so, the error message is written

15    in procedural step 207 to the internal EEPROM 15 of microcontroller  $\mu$ C via module 13. This error message is already prepared and is loaded into the memory as a function of the output signal of AND gate 13. Procedural step 208 tests whether or not it was possible to read the error message in

20    memory 15. If this is the case, the warning lamp is left on in procedural step 210. If this is not the case, the lamp is deactivated in procedural step 209. This occurs in particular due to the fact that no error message was present in memory 15. That eliminates the error bit, and only logical zeros

25    remain at the inputs of OR gate 16.

In particular in the case of brief interruptions which occur during operation, timer 10 must be ineffectual, since it ensures that sufficient time is made available during the power-up period for oscillation to begin and no error is

30    stored.

On the basis of the description of the present invention, it is clear to a person skilled in the art that the exemplary embodiment shown in Figure 1 may be varied, while still

implementing the present invention. In particular, the nature and placement of the error memories may be modified.